Spring 2018

Observational Study to Identify Best Practices of Successful Active Science Programs

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Abstract

Introduction: Obesity amongst our nation's youth is on the rise and has drastically increased in recent decades. This chronic health issue lends to potential risk of developing comorbidity of type 2 diabetes, hypertension, heart disease, an increased risk of premature death and many other serious chronic diseases. Obesity prevention and health promotion programs aimed at targeting obesity, and more specifically childhood obesity, should implement nutrition and/or physical activity components. Effective programs have taken into account moderate- to vigorous-intensity physical activity (MVPA) measurements, class size and class management (if the program utilizes an education or group fitness component), and the demographic needs of the population.

Research Questions: The purpose of this research is to develop a plan of best practice for Active Science, a nationwide obesity prevention program, based on classroom management strategies as well as physical activities that maximize MVPA. By implementing effective classroom management techniques and physical activities, MVPA will increase amongst children, decreasing childhood obesity rates and increasing the validity of Active Science.

Methods: Active Science classes at the highest performing and lowest performing sites in the Merrimack Valley were observed for three weeks. Detailed notes on 11 observational points (including but not limited to: MVPA, Step Count, Classroom Management Techniques, etc.) were taken and a comparative analysis was performed to produce a comprehensive list of best practices to improve the overall consistency and success of Active Science.

Results: The results of this study proved the research hypothesis correct in that effective classroom management techniques and modified physical activites increace MVPA.

Conclusions: It can be concluded that this study was successful in identifying several ways to increase MVPA within Active Science classrooms through effective classroom management and modified activities. However, more research is needed to fully create a comprehensive list of best practices for Active Science.

Observational Study to Identify Best Practices of Successful Active Science Programs

Introduction

Obesity: An Epidemic

Obesity is a chronic disease sweeping the nation and is typically caused by lifestyle choices such as poor diet and/or sedentary lifestyle. Current research states that the energy gap, the number of calories consumed beyond what the body is able to burn in a day, that has led to today's obesity epidemic is at a minimum of 300 extra calories per day (Snelling, 2014). According to the Dietary Guidelines for Americans 2015-2020, the leading calorie contributors to the average American's diet are as follows: grain-based desserts (cakes, cookies, pies, donuts, etc.), yeast breads, fried chicken, drinks high in sugar (sports drinks, soda, and energy drinks), pizza, pasta, and alcoholic beverages. High intake of these foods has led to concerning levels of obesity amongst children and adults in the United States (U.S. Department of Health and Human Services 2015). Obesity for children (aged 6-17) is defined as a BMI at or above the 95th percentile for children of the same age and sex (Centers for Disease Control and Prevention, 2017b).

Individuals suffering from obesity are at risk of developing many other chronic diseases. Obesity has been linked to increased risk of premature death, type 2 diabetes, hypertension, dyslipidemia, heart disease, stroke, gallbladder disease, sleep apnea, arthritis, and several kinds of cancer (Snelling 2014). Risk factors for obesity include: biological determinants of health i.e. genetics; social determinants of health such as behavior; education, socioeconomic status, adversity and chronic stress, and cultural norms, as well as environmental determinants of health i.e. access to nutritious food and safe recreation areas. Behaviors that affect a person's weight are diet, exercise, medication use, and sleep routines (Centers for Disease Control and

Prevention, 2017b).

Health Disparities. Currently more than one-third (36.5%) of U.S. adults are obese and approximately 17% of children (aged 2-19 years) are obese. The estimated annual medical cost of obesity in the United States in 2016 was $190.2 billion with childhood obesity accounting for nearly $14 billion. Individuals suffering from obesity paid on average $2,500 more than those of a normal weight (Centers for Disease Control and Prevention, 2017a). Health disparities amongst ethnicities and socioeconomic backgrounds are of notable concern as well. The health disparities of obesity among children are the following: Hispanic children have the highest rates of obesity (21.9%), followed by non-Hispanic blacks (19.5%), and non-Hispanic whites (14.7%), then non-Hispanic Asian children (8.6%). Childhood obesity has reached rates of 20.5% amongst adolescents aged 12-19, 17.5% amongst children aged 6-11, and 8.9% amongst children ages 2-5 years (Centers for Disease Control and Prevention, 2017a). According to the Centers for Disease Control and Prevention (CDC), obesity disproportionately affects children from low-income families.

Healthy People 2020 reports that childhood obesity has been positively associated with screen time. The American Academy of Pediatrics (AAP) recommends 2 hours or less per day of screen time for children 2 years of age or older. Children in the U.S. aged 8-18 report 7 hours of screen time per day on average and children aged 5 years and younger have been reported on average to spend 2 hours per day looking at a screen (Office of Disease Prevention and Health Promotion, 2017).

Treatment. Treatment recommendations for individuals suffering from obesity are improvement of diet and increased physical activity. The following are guidelines for nutrition and exercise for Americans and can be used as obesity treatment or preventative measures. When attempting to achieve and maintain a healthy weight, it is important to note that these guidelines represent lifestyle changes, not short-term diets or exercise programs.

The Dietary Guidelines for Americans 2015-2020 are to develop a healthy eating pattern by consuming less than 10% of daily calories from added sugars, less than 10% of calories per day from saturated fats, and less than 2,300 milligrams (mg) per day of sodium.

The 2010 Dietary Guidelines Advisory Committee identified the most common global dietary patterns and the associations those diets have with disease risk. The top four global dietary patterns are the Westernized Diet, the Mediterranean-style diet, the vegetarian diet, and the traditional Southeast Asian diet. The Westernized or American Diet is high in added sugars, calories, solid fats, and sodium, linking it to increased risk for obesity, premature death, cardiovascular disease, type 2 diabetes, and other chronic diseases. The Mediterranean and Asian diets are high in fruits, vegetables, seafoods, and whole grains and are associated with a lower risk of disease.

In addition to developing a healthy eating pattern, individuals suffering from obesity should slowly adjust their lifestyle to incorporate the Physical Activity Guidelines for Americans. Incorporating regular physical activity into the lives of children leads to important life long benefits. Children who are physically active are healthier and fit and have a reduced risk of chronic disease in their future.

The Physical Activity Guidelines for Children (aged 6-17) are 60 minutes or more per day of physical activity with the majority of the 60 minutes spent in a moderate-vigorous

intensity aerobic activity and include vigorous activity at least 3 days per week (U.S. Department of Health and Human Services 2008).

Literature Review

Obesity prevention programs. Preventative programs addressing childhood obesity are popping up all over the nation. These programs are comprehensive lifestyle guides for students and aid in the learning and behavior curbing process to help students reach and maintain a healthy weight. Programs include diet-only interventions, physical activity-only interventions, and multifaceted interventions.

The Community Preventive Services Task Force (CPSTF) supports and provides evidence based on a meta analysis of 25 studies with 26 study arms that meal and fruit and vegetable snack interventions within schools increases nutritious food and beverages available to students through school meal policy change. By adapting school meal policies, students receive breakfast and lunch that meet the nutritional requirements of the national dietary guidelines, fruit and vegetable snacks are provided to them, positive fruit and vegetable marketing strategies are posted throughout the school to promote education and social stigma as well as positive connotations of healthy snacks, also, students are enrolled in a nutrition course. The CPSTF found meal interventions to be effective based on evidence that if fruit and vegetable consumption increases then rates of obesity will be maintained or reduced. Economic evidence shows that meal interventions are cost-effective. The CPSTF states that the average cost of a meal and snack intervention is about $170 and the average averted annual healthcare cost is around $400 making the net benefit an average of $230 (Community Preventive Services Task

Force, 2017a).

The Community Preventive Services Task Force also supports physical activity-only interventions. The CPSFT's systematic review of 14 peer reviewed articles studying physical activity-only interventions found that enhanced school-based physical education (P.E.) increases physical activity amongst youth. According to the CPSFT, an enhanced P.E. class incorporates teaching strategies such as modifying games, substituting less active games with more active games, etc. and/or physical education lesson plans that incorporate fitness and circuit training activities into sports activities. The findings of the systematic review state that enhanced school-based P.E. includes curriculum change to increase the amount of time students spend in moderate- or vigorous-intensity physical activity (MVPA) during an P.E. class. The evidence states that in intervention groups (groups with an enhanced P.E. class) there was a 10.37% increase in the amount of MVPA time than in groups without an enhanced P.E. curriculum. This systematic review was conducted by a team of specialists in systematic review methods, and in research, practice, and policy related to increasing physical activity (Community Preventive Services Task Force, 2017b).

In a systematic review of peer reviewed literature conducted by the Community Preventive Services Task Force on behalf of the Healthy People 2020 campaign, behavioral interventions aimed to reduce recreational sedentary screen time among children aged 13 years and younger are effective in increasing physical activity, improving diet, and improving or maintaining weight-related outcomes. This review is based on 49 studies with 62 control arms conducted in a search period of 1966-June 2013. Based on the findings of the systematic review of interventions that focus only on reducing recreational sedentary screen time and studies that focus on reducing recreational sedentary screen time and improving physical activity and/or diet,

behavioral interventions are effective at teaching behavioral self-management skills to initiate or maintain behavior change. Effective interventions include the use of one or more of the following components: classroom-based education, tracking and monitoring through use of an electronic device, coaching and counseling sessions, and family-based or peer social support.

Screen time outcomes report an average decrease of 30 minutes per day in interventions solely focused on reducing screen time. In interventions aimed at both reducing screen time and increasing physical activity, there was an average of 130 step increase per day and a positive effect on screen time reduction. Dietary outcomes for screen time-only interventions yielded a 75 kcal decrease per day and in interventions aimed at both reducing screen time and increasing physical activity, there was an average decrease of 118 kcals per day. Overall, there was an average of 3.3% reduction in obesity prevalence (Community Preventive Services Task Force, 2017c).

The evidence gap in this systematic review includes information regarding intervention effectiveness among teens older than 13 years of age and adults and other benefits and implications of reduced screen time. For example, does a reduction in screen time mean other sedentary behaviors will be substituted (e.g., reading for leisure, listening to music, time spent on homework)? Do reductions in screen time lead to other health benefits, such as improved sleep quality (Community Preventive Services Task Force, 2017c)?

A recent systematic review of peer reviewed literature conducted by the Community Preventive Services Task Force for the Healthy People 2020 campaign focused on the effectiveness of activity monitors in increasing physical activity time amongst obese and overweight adults. This review consisted of 14 randomized controlled trials and determined that activity monitors are an effective way to increase MVPA amongst overweight or obese children

and adults, however, more research is needed to determine if the increase is maintained over time. Effective interventions that included an activity monitor such as pedometers or accelerometers also included behavioral instruction in the form of counseling, group-based education, or web-based education. When compared with control groups (groups without activity monitors or behavioral instruction), interventions reported statistically significant increases in steps per day and minutes spent engaging in MVPA per week (Community Preventive Services Task Force, 2017d).

In a systematic review of 19 peer reviewed studies, the Community Preventive Services Task Force found that family-based interventions increased physical activity among children. This type of physical activity intervention combines activities to build family support with health education to increase physical activity among children aged 5-12 years of age. Effective interventions included goal-setting tools and skills to monitor progress, reinforcement of positive health behaviors, such as reward charts or role modeling of physical activity by parents or instructors, and/or organized physical activity sessions, such as instructor-led opportunities for active games. Interventions may also include nutrition education or efforts to reduce screen time (Community Preventive Services Task Force, 2017e). Physical activity among children in the intervention groups increased by a small but statistically significant amount and studies that directly measured physical activity with activity monitors showed slightly greater increases than studies that used self-reported data. There is still more evidence needed to see how effective interventions are when targeted to certain groups based on demographic characteristics, which combination of intervention components are most effective, and if the duration of the intervention has an effect. With current data, these findings are applicable to families with children aged 5-12 (Community Preventive Services Task Force, 2017e).

Active science. Active Science is a childhood obesity prevention program currently being implemented across the nation in both during-school and after-school settings. It is a grassroots initiative designed to promote improved physical activity and educational achievement. Through the use of instructor-led opportunities for active games monitored by accelerometers or pedometers, this obesity prevention program encourages students to be physically active and teaches the skills needed to live an active lifestyle. Active Science has two major components: physical activity and STEM (Science, Technology, Engineering, and Mathematics) education. Through the use of a mobile app and tablet technologies, students are able to learn, track their progress, and play educational games with the aim of closing academic achievement gaps, reduce summer learning loss, and addressing key educational priorities (Active Science, 2016). The creators of Active Science have found that the states with the highest prevalence of childhood obesity also have the lowest STEM test scores. According to the Active Science research team, several studies have proven that physical activity improves academic outcomes including: overall academic success, cognitive performance, and reading and math skills, as well as, improved levels of concentration and increased time on-task in the classroom. Based on the aforementioned evidence, Active Science chose to develop a program that addresses both physical activity and STEM education.

The pilot study of the Active Science program proved that in comparison to typical after school programs, students aged 5-14 were more physically active (mean steps: 1826 and 685 respectively and MVPA %: 39% and 30% respectively). Evidence also supported Active Science in improving science scores from a pre and post test (Mean score: 58 and 70 respectively) (Finn, Yan, Martin, & McInnis, 2016).

Active Science is currently being implemented in 3 YMCAs in the Merrimack Valley: Andover, Lawrence, and Methuen. According to the raw data report, Lawrence has the highest enrollment rate with approximately 60% of the total Merrimack Valley enrollment attending it's program, and the lowest time spent in moderate- to vigorous-intensity physical activity with an average of 42% of MVPA time over exercise time in comparison with Andover who has the highest percentage at 50% (Active Science: Merrimack Valley YMCA Data Summary, 2017). Goals of each Active Science session are to have each student take 2,500 steps or more and have each student spend 30 minutes or more in MVPA. According to the raw data from this term (September-November 2017), Andover recorded students taking an average of 2,800 steps per session and spending an average of 10 minutes in MVPA, while Lawrence recorded students take an average of 1,750 steps and an average of 6 minutes in MVPA per session (Active Science: Merrimack Valley YMCA Data Summary, 2017).

When looking at the differences between Andover and Lawrence, not only are steps and MVPA drastically different, socioeconomic status and class size are different. Socioeconomically, 30% of lawrence residence fall below the poverty line which is much higher than the national average of 14.7%. In Andover, the poverty rate is only 10.7% and with a median annual household income of over $77,000, Andover far exceeds the median annual household income in Lawrence of just under $35,000 (Data USA, 2015). Class sizes are also drastically different. At the Andover YMCA, students participating in Active Science have small class sizes with an average of 12 students and in Lawrence the average class size is approximately 25 students (Active Science: Merrimack Valley YMCA Data Summary, 2017). Larger class sizes and lower socioeconomic status lead to poor or disruptive behavior in the

classroom meaning that more time is spent on classroom management than in classes of a smaller size with students who do not face the challenges of low socioeconomic status.

Measurements. When implementing a program, no matter the purpose, it is important to evaluate the effectiveness in order to expand upon or improve the program as a whole. The following are means of measurement for effective obesity prevention programs: Class size, class management, both management techniques and time spent addressing disruptive behavior, and moderate- to vigorous-intensity physical activity.

Class size. In a 2014 study examining the associations between specific environmental characteristics (teacher characteristics; class size, duration and location; and lesson context) and elementary school-aged children's MVPA during P.E., researchers found that physical activity may be influenced by environmental factors such as class size, location, and lesson contexts. These findings hold important policy implications for P.E. class organization and the need for strategies that maximize children's MVPA (Skala, Springer, Sharma, Hoelscher, & Kelder, 2012). The study measured MVPA of 211 students in grades 3, 4, and 5 during P.E. at 74 Texas public school. Students engaged in 38% their P.E. class time in MVPA, while approximately 25% of class time was spent in classroom management. Percent time in MVPA was significantly higher in outdoor classes compared with indoors (41.4% vs. 36.1%, $P = .037$) and larger ($P = .044$), longer ($P = .001$) classes were negatively associated with percentage of MVPA and positively correlated with time spent in management ($P < .001$) (Skala, et al., 2014).

Bosworth (2014) conducted a study in 2014 examining 4th and 5th grade students in North Carolina and found that students who struggle in school appear to benefit more from class

size reductions. This is important to note when working a) in the public school system and b) when working in impoverished areas. Bosworth (2014) also found that smaller classes have smaller achievement gaps on average, thus, class size reductions are effective at closing achievement gaps. Conversely, Bosworth (2014) also concluded that size reductions close achievement gaps, not raise average achievement. Further research should be done to determine the validity of this conclusion.

In juxtaposition to the above findings, according to Clark, Lotto, & McCarthy (1980), assistance to individual students can be provided more effectively by adding a tutor than by manipulating class size. However, this study was an observational study based on the principle of "point of effective action", principals tend to affect teachers; teachers affect students and therefore assistance to individual students can be provided more effectively by adding a tutor than by manipulating class size due to a higher teacher ratio.

Class management. Often times, students believe the misconception that P.E. is an opportunity to fool around and act reckless, however, this misbehavior is disruptive to the physical activity curriculum and prevents the class from achieving learning objectives. Consequences of disruptive behavior are multifaceted, it interferes with student academic learning time which correlates highly to student achievement; makes well behaved students feel uncomfortable when teachers reprimand disruptive ones; prevents teachers from implementing curriculum; contributes toward teacher burnout; and enhances perception of teacher incompetence (Vogler, E. W. & Bishop, P., 1990). Research in regards to behavior management in a P.E. setting is mainly limited to special populations, i.e. populations with disabilities. The purpose of the following study was to manage behavior in an activity-based setting. According

to Vogler and Bishop (1990), there is general agreement that teacher variables such as age, gender, and educational background have marginal impact on student achievement, however, context variables such as class size, school environment, and student socioeconomic background are known to be a more powerful predictor of student achievement. Specific teacher variables studied in this project were age, gender, and educational coursework and background, while the context variables were grade level, class size, and teaching site. The researcher identified 29 behavior management strategies and asked teachers to rank them (1-29, 1 being most used and 29 being not used at all). Teachers were then asked to rank the strategies on the Likert scale (I - Not at all, 2 - To a very little extent, 3 - To some extent, 4 - To a great extent, 5 - Completely) to indicate the extent to which they used the 29 behavior management strategies in either mildly, moderately, or severely disruptive situations. The results of this study showed that teachers most commonly utilized praise of appropriate behavior and non-verbal disapproval of disruptive behavior for both mild and moderately disruptive situations. However, for severely disruptive situations, the most common method was having the disruptive student(s) sit out (Vogler & Bishop, 1990). This study showed the most common behavior management strategies utilized in a P.E. setting by experienced teachers.

In another study, Fink & Siedentop (1989) found that teacher effectiveness was associated with skillful classroom management. The researchers concluded that important elements of effective behavior management are the composing of routines, rules and expectations from the start of the school year and teaching those rules, routines, and expectations using repetition and active participation until the class understands and performs them satisfactorily. Effective teaching is also closely identified with gains in student achievement and an improvement of attitude on the part of students.

MVPA. According to the Physical Activity Guidelines for Children (aged 6-17), children should attain 60 minutes of physical activity daily and >30 minutes of MVPA should be obtained during the school day with 50% of MVPA occuring during physical education classes or after-school physical activity programs. Schools have been identified as primary societal institutions for promoting children's physical activity, however, ethnic minority children living in high poverty neighborhoods are at high risk of having insufficient physical activity during school days and, thus, the importance of school as a place to facilitate physical activity in these underserved children has been largely emphasized in research and program implementation. Physical education lessons have the potential to increase daily MVPA and reduce sedentary time, (Brusseau & Kulinna, 2015; Mooses, Pihu, Riso, Hannus, Kaasik, & Kull, 2017; Youngdeok & Lochbaum, 2017).

Brusseau and Kulinna (2015) conducted a study comparing the effectiveness of 4 traditional school-based physical activity models using MVPA and step counts as a measurement tool. The 4 models are as follows: recess only, multiple recesses, physical education only, and recess accompanied by physical education. Data was collected on 5 consecutive days from 298 children in grade 5. The results of the study were that children accumulated the greatest amount of steps and MVPA time on days when physical education and recess both occurred (5,242 ± 1,690 steps; 15.3 ± 8.8 min of MVPA). Students participated in the least amount of physical activity on days with only a recess opportunity (3,312 ± 445 steps; 7.1 ± 2.3 min of MVPA). Overall, students accumulated an additional 1,140 steps and 4.1 min of MVPA on days with physical education class. Brusseau and Kulinna (2015) concluded that P.E. class is the most important school physical activity opportunity for maximizing children's overall active time.

Physical education is not offered every day of the week, therefore there is a majority of days where students do not have an opportunity to get active during the school day. In a study conducted in 2017, researchers looked into quantifying how much MVPA time is gained and how much sedentary time is reduced through physical education classes and compared physical activity (measured by MVPA) on days with and without physical education class. Physical activity was recorded for 504 students ages 7-12 during one school week. The results of the study were that students, on days with P.E., had 12.8 minutes more MVPA and 9.7 minutes less sedentary time compared with days without P.E. In P.E., students spent 28.6 ± 6.5% in MVPA and 29.3 ± 9.8% in sedentary time and each additional MVPA minute in P.E. was associated with 1.4 more daily MVPA minutes (Mooses, et al., 2017). One can conclude that P.E. significantly increased daily MVPA and reduced sedentary time, confirming the important role of PE in supporting the healthy development of children regardless of the fact that MVPA time in class was lower than sedentary time.

Youngdeok, et al. (2017) conducted a study examining the levels and patterns of physical activity in minority children, with a focus on the relative contributions of regular physical education and school-based afterschool physical activity programing in promoting MVPA during school days. An accelerometer was used to collect data across 5 school days per child for 75 children enrolled in an urban public elementary school in a high poverty neighborhood in the United States. The minutes and percentage of MVPA accumulated during school, PE, and afterschool PA program were compared to the current recommendations (previously stated in this literature review) as well as by demographic characteristics (sex, grade, ethnicity, and weight status) using a general linear mixed model that accounts for repeated observations (Youngdeok, et al., 2017). On average, students spent 41.6 minutes in MVPA during school hours and of

those, 14.1 minutes were contributed during P.E. The average proportion of time spent in MVPA during P.E. was 31.3%, which was significantly lower than the recommendation (≥50% of MVPA should occur during P.E.), whereas 54.2% of time in afterschool PA program were spent in MVPA. Based on these findings, Youngdeok, et al. (2017) concluded that school-based afterschool physical activity programs, in addition to regular P.E. classes, will greatly increase physical activity promotion amongst school-aged children.

Conclusion

In conclusion, childhood obesity is a pressing health issue in need of attention. Active Science is an obesity prevention program affecting the lives of K-6th grade students nationwide with disparities across all sites of implementation. The above research will help limit the differences in delivery and increase effectiveness. Effective class management is closely identified with gains in student achievement and an improvement of attitude on the part of students. Through the use of management techniques such as routines, rules, and expectations being established at the start of the program, smaller class size or increases in instructor presence, MVPA will consequently increase.

MVPA is an effective tool to measure the effectiveness of a program or P.E. class because there are supported recommendations to strive to reach and the closer to reaching or exceeding those recommendations the program is, the more effective it is at increasing appropriate physical activity amongst children. Based on the studies above, the greatest amount of time spent in MVPA is during physical education classes or after-school physical activity programs, however, these programs are not reaching their full potential. Using the information above, a plan of best practice for Active Science should be created to improve minutes in MVPA

in order to more effectively achieve its goals to educate students and decrease childhood obesity rates. Through the conduction of an observational study, current practices that are successful and detrimental to Active Science will be identified, modified, and implemented to push the program to new successes and decrease childhood obesity rates across the nation.

Method

Participants

A total of 15 Active Science sessions were observed over a three week period. A total of 87 third through fifth grade, male and female students participated in the observational study. There was 24 students of middle-upper socioeconomic status (2 classes) and 63 students, or 3 classes of low socioeconomic status. There was a sampling imbalance due to the larger class sizes for the lower socioeconomic status students. Active Science is a youth obesity prevention program taking place in YMCA's across the nation. For ease of access and time constraints, a convenience sampling method was utilized. While the limitations of a convenience sample have been noted, the populations and classroom demographics being studied are similar to those of participating YMCA's across the country. Limitations of convenience sampling include: lack of randomization, making generalizability questionable or biased, however the demographics of the chosen populations well represent other Active Science classes nationwide.

Measures

There was a 3 week observation period. During this time, the researcher observed 6 Active Science sessions at the Andover YMCA, 3 small classes with third through fifth grade boys and girls of middle-upper socioeconomic status. During this time, 9 sessions at the Lawrence YMCA were observed, consisting of larger class sizes of third through fifth grade boys and girls of lower socioeconomic status. This observation period consisted of detailed note taking, observing class size, classroom management techniques, time spent disciplining children, step count, and time students spent in moderate-to-vigorous-intensity physical activity (MVPA). MVPA was measured through the use of a wearable fitness technology, called an accelerometer. A detailed checklist of key observation points can be found in Appendix A.

Procedures

First, it should be noted that this research study is approved under the existing Active Science IRB. Second, 6 sessions were observed at the Andover YMCA, with detailed notes regarding class size, classroom management techniques, time spent disciplining children, and time students spent in MVPA. Then, 9 sessions were observed at the Lawrence YMCA, with detailed notes observing class size, classroom management techniques, time spent disciplining children, and time students spent in MVPA. After the observation period concluded, a comparative analysis was conducted on the 3 weeks of notes from both the Andover and

Week		1	2	3	4	5	6	7
IRB Approval	COMPLETED							
Observation Period								
Comparative Analysis								
Creation of Best Practices								

Lawrence Active Science classes. At the conclusion of the comparative analysis, a plan of best practice was developed for the Active Science youth obesity prevention program.

Data Analysis

This is an observational study with a comparative analysis of detailed notes regarding class size, classroom management techniques, time spent disciplining children, and time students spent in moderate- to vigorous-intensity physical activity.

Results

Demographics

Five Active Science classes participated in this study. The participant pool consisted of third through fifth grade students, sixty-three of which were from Lawrence, MA and twenty-four students were from Andover, MA. There were two classes studied at the Andover site and three classes studied from the Lawrence site. Andover classes have a total of 60 minutes allotted for Active Science whereas Lawrence has a total of 90 minutes for class. Tables 1 and 2 provide further demographic information regarding each of the 5 classes that participated in the study.

Table 1: Demographic Information of Participants (n = 87)

Variables	Number	Percentage
Andover	24	28%
Lawrence	63	72%
Age	8-11	100%

Table 1 above highlights the demographic information of the 87 participants. The information provided includes the number of students reached per site and the age range of those students.

Table 2: Demographic Information Regarding the Five Classes Studied

Class Number	Location	Class Length	Class Size	Grade Level
1	Andover	60 min	12	2nd and 3rd grade
2	Andover	60 min	12	4th and 5th grade
3	Lawrence	90 min	20	3rd grade
4	Lawrence	90 min	22	4th grade
5	Lawrence	90 min	21	5th grade

Table 2 above illistrates the location, class length, class size, and grade level of each of the five classes studied.

Quantitative

After observing three weeks of Active Science classes in both the Andover and Lawrence locations the following was recorded: average step counts, time spent in physical activity (PA), time spent in moderate-to-vigorous physical activity (MVPA), time spent starting up, time spent in transition (shifting from one activity to another), time spent drinking water, and time spent on the tablets. The two sites proved to report drastically different numbers. In Lawrence, over the course of three weeks, students averaged 26+-6 steps per minute while in class whereas, students in Andover only averaged 17+-3 steps per minute over the course of three weeks. In week one, Lawrence reported an average of 22 steps per minute while Andover reported an average of 18 steps per minute. Lawrence went on to report an average of 23 and 33 steps per minute in weeks two and three respectively while Andover reported an average of 14 steps per minute in week

two and 20 steps per minute in week three. The data collected during the observational period in 2018 countered the data presented from 2017. As Table 3 illustrates, Lawrence classes took more steps on average than Andover classes and have a higher percent of class time spent in MVPA.

Table 3: Average Steps Per Minute and Average Percent of Class Time Spent in MVPA During Active Science

Variables	Avg Steps Per Min	SD	Avg % MVPA	SD
Lawrence				
Week 1	22		13	
Week2	23		15	
Week3	33		19	
Total	26	6	15.9	3.055
Andover				
Week 1	18		5	
Week 2	14		0	
Week 3	20		7	
Total	17	3	3.95	3.606

Table 3 depicts the average steps taken per minute during Active Science for both the Lawrence and Andover sites as well as the average percent of class time spent in MVPA for both sites.

Qualitative

One of the main objectives of Active Science is to get kids moving. This is measured by MVPA, or time spent in moderate-to-vigorous physical activity. The following chart (Figure 1) is a visual representation of the average percent of class time students spent in MVPA each week at each site compared with time spent in physical activity, transitioning, starting class, water breaks, tablet time, and inactive time.

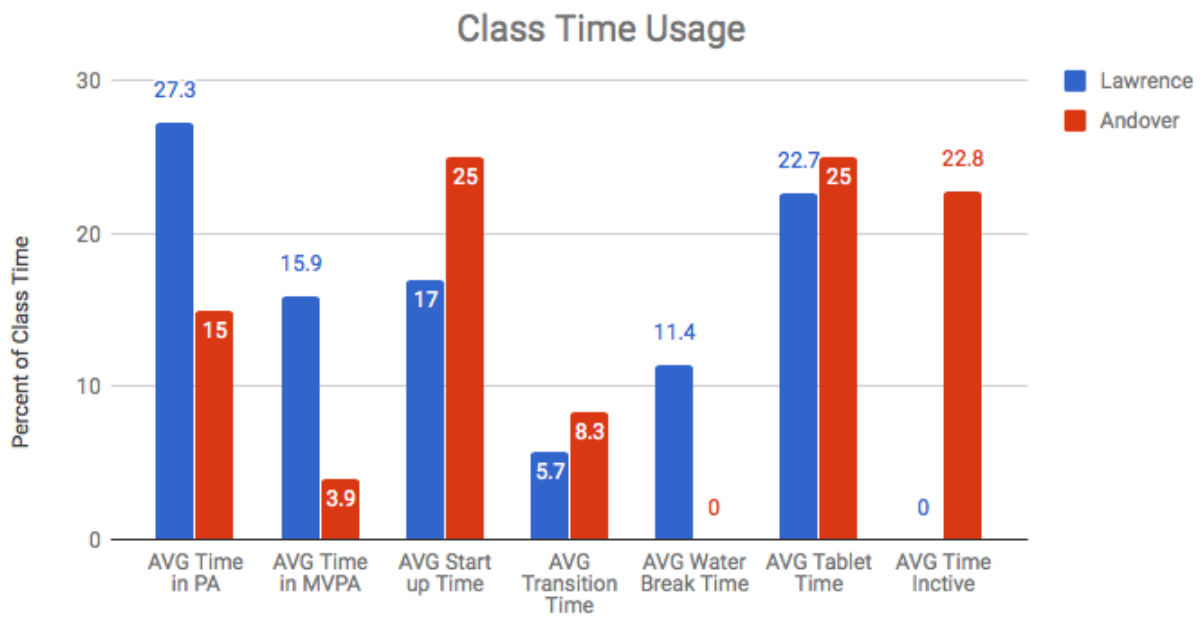

Figure 1 demonstrates the use of class time by percentage for the Active Science site in Lawrence, MA over a three week time span.

The results of this observational study showed that overall Lawrence Active Science classes were more active. From observation, the activities utilized in Lawrence substituted regular or typical P.E. games (i.e. Freeze Tag, Elimination Dodgeball, Elimination Musical Cones, etc) for more active versions (i.e. Active Tag, Continuous Dodgeball, Continuous Musical Cones) where as in Andover relay games where only one student per team is moving at a time or typical P.E. games were the primary activities utilized. Observations also showed that tablet time is integrated into active time in the Lawrence classroom whereas in Andover the students use the tablets for a desginated period of time at the end of the class. For example, in Lawrence sections of Active Science, the last activity is typically a team activity with a round-robin style tournament. The teams who are on their break will use the tablets and when they are done, the teams playing utilize the tablets and the teams who finished the tablets begin their game. It was observed that instructors at both sites spent time participating in activities along

side students to increase positive reinforcement and “role-modeling” of physical activity. Both sites had set rules and expectations of students for their classtime and it was observed that students knew and understood these rules and expetations at the start of class, however, as the class went on transitions became harder as student attention to detail regarding class expectations deterioated. It was also observed that classtime was wasted at the start primarily due to tardiness.

Discussion

Overview and Major Findings of the Study

The current study looked to determine the best practices for a youth obesity prevention program, Active Science, thorugh examining different varieables such as classroom management techniques and physical education activites focuesed on improving MVPA amongst students. The major findings were as follows: 1. Modifying typical P.E. games to gmaes focused on improving MVPA increases moderate-to-vigourous intensity physical activity amonst praticipants. 2. Class size made no significant impact on class effectiveness as the student-teacher ratio was the same at both sites. 3. Role modeling physical activity by having instructors periodically participate amongst students visibly increased student morale and subsequetly increased student activity. 4. Establishing and maintaining classroom routine is extremly important in increasing MVPA during classtime. 5. Minimizing tardiness to maximize the use of class time will lead to an increase in MVPA. It is important to note that class length may not be possible to modify, increasing the importance of punctuality and classroom management to maximize the use of class time to increase MVPA.

Correlation Between the Present Findings and Literature

The findings of the current study are consistant with the research hypothesis that implementing effective classroom management techniques and physical activities, MVPA will increase amongst children, decreasing childhood obesity rates and increasing the validity of Active Science. This finding is promising as the discovery of this information will allow for increased consistency in a national youth obesity prevention program and increased MVPA of the program's participants. This information will allow for instructors to imporve on the delivery of the program and increase the health of children across the United States.

The current findings coinside with past findings from the literature that suggest that implementing classroom management techniques such as routine and expectation establishment, as well as increasing modified games for maximal activity increases the amount of time spent in MVPA (Fink & Siedentop, 1989, Brusseau & Kulinna, 2015). Additionally, previous literature suggests that composing routines from the start of the school year (or start of the program) and teaching those rules, routines, and expectations using repetition and active participation until the class understands and performs them satisfactorily increases class effectiveness. Effective teaching is also closely identified with gains in student achievement and an improvement of attitude on the part of students (Fink & Siedentop, 1989).

Strengths and Limitations of the Study

A strength of the present study was the population involved. Students in the observed classes were of an age range representative of all those who are involved in the Active Science program nation wide as well as from different cultural and socioeconomic backgrounds. This is an important strength because it can help establish generalizability and allows for the researcher

to rule out age, socioeconomic status, and cultural background as compounding variables in this study. A second strength of the present study was the mixed method approach to data collection. Both quantitative and qualitative data were collected allowing for a well rounded view of the function of the class observed.

The primary limitation of this study was that the different sites observed provided different services for child care. Lawrence's Active Science program is provided to students through their enrichment period during the school day. Students are required to attend and do so while at school. Andover's Active Science is an afterschool program and therefore presents a multitude of differences and limitations to the study. In an afterschool program, there are less students to participate in the program, there is often less structure, and students may leave early due to partents picking up their children when they get out of work rather than when the after school care ends. This may be one explaination as to why Andover reports such low MVPA scores. Another possible explination for the low MVPA reports could be the weather during the observation period. The Andover YMCA closed during the observation period for two days due to inclimate weather and power outages, reducing the amount of class time for Active Science during that time. Another limitation to this study was that a convienece sampling method was used to gather participants. This sampling method was conducive to the researcher's time, monitary, and traveling resrictions, however, it places a limitation on generalizability.

Future Direction and Practical Application for the Study

Future studies on Active Science should look to compare like programs rather than comparing enrichment to after school care. Future studies should also look to expand the participant base to sites across the nation to gain more general insight as to how to better

imporve the program to increase MVPA and the consistency of implementation. The practical application of the current study is as follows: increasing MVPA within Active Science classes needs to be more consistent across the nation providing further validity of the program. To increase consistency and MVPA across all Active Science classes, classroom managemnt techniques and modified P.E. games need to be implemented. These findings can be generalized to Physical Education classes in all school settings as well.

Conclusion

The findings of this study shed light on the importance of classroom management and utilizing the alloted time to its utmost capacity to increase MVPA amongst children. It also proved that substituting P.E. games for even slightly more active versions allow for students to increase the time they spend in MVPA as well as keeps students actively engaged and learning. Example P.E. games focusing on increasing MVPA can be found in Appendix B. A comprehensize list of recommended best practices can be found in Appendix C.

The present study contributes to the knowledge in the elementary school physical education, afterschool programing, and youth obesity prevention programming fields. Professionals within these field recognize the importance of achieving and maintaining MVPA and the current study provides further insight in imporving the health of children through these iniatives.

Appendix A

Observational Checklist

- Implementation of modified games, i.e. substituting less active games with more active games, etc. and/or physical education lesson plans that incorporate fitness and circuit training activities into sports activities
- Use of activity monitors
- Goal-setting by students to monitor progress
- Reinforcement of positive health behaviors, such as reward charts or role modeling of physical activity by instructors
- Organized physical activity sessions, such as instructor-led opportunities for active games
- Use of the mobile app and tablet technologies
- Step count per student, i.e. each student should take 2,500 steps or more per session
- Time in MVPA, i.e. each student spends 30 minutes or more in MVPA
- Time spent on classroom management
- Class size
- Classroom management techniques
    - Classroom expectations
    - Class rules
    - Classroom routines

Appendix B

Modified P.E. Games

- Substitute Freeze Tag with Active Tag. In Freeze Tag, a few students are assigned to be taggers and when a student is tagged they must freeze until freed by a fellow classmate. Active Tag encourages students to stay active and increase MVPA by have students perform 5-10 repititions of an activity such as sit-ups or jumping jacks.
- Stustitute Elimination Dodgeball with Continuous Dodgeball. Here, instead of being eliminated from the game when hit with a ball, the student simply switches teams. The game ends when time runs out or all students are on the same team. Continuous Dodgeball encourages students to keep active and focuses on increasing MVPA.
- Substitute Elination Musical Cones with Continuous Musical Cones. Instead of being elminated when the student is unable to find a cone when the music stops, they must perform a certain number of repitions of an exercise before rejoinging the game i.e. jumping jacks or sit ups. This version of Musical Cones allows students to continue to participate in the activity and allows for a greater amount of time to be spent in MVPA.
- Substitute Red Light, Green Light with Active Red Light, Green Light. In Red Light, Green Light, students freeze when the instructor calls out red light and run when the instructor calls out green light. In Active Red Light, Green Light, students perform an exercise when the instructor calls out red light and then run when the instructor calls out green light. This activity allows for a greater amount of time spent in MVPA

Appendix C

Recommended Best Practices for Active Science

1. Instructors cannot always control class length or the tardiness of their students, but they can control their time management. When classes are tardy or shorter in length is is essential to optimize class time in order to get students moving faster for longer periods of time. Come to class prepared with a plan and if the students are not responding to your activities, have a back up planned.
2. Utilize modified games focused on increasing MVPA. For some examples please see Appendix B.
3. Classroom management is a key part of optimizing class time useage. Set rules, routines, and expectations early on. Take time to teach and practices these rule, routines, and expectations so that students know what your standards are and that they will be held to them. This allows students to learn what is expected of them each time they enter your space.
4. Instructors should get involved! Not only is it the instructors responsibility to run class in a safe and responsible mannor, they should be actively engaging with students. This increases students' postive personal attitude and social norms surrounding physical activity and encourages them to get involved.
5. When working with young students, they can often become overwhelmed with excitement. Instructors should remain positive and patient and positively reinforce good behavior.
6. Activity monitors can sometimes be a distraction. Instructors should encourage students not to look at their step counts until the end of class.

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